YogaForm: Yoga Pose Correction AI Web Service Using Pose Estimation Model

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Abstract. Yoga is an easy exercises to try at home alone, given that it can be done anytime, anywhere with just a single mat. But it is difficult to check your posture if you do yoga alone at home. To solve this problem, we propose a yoga pose correction AI web service "YogaForm". it detect the user's posture using posture estimation AI model and provide immediate feedback compared to the standard posture. It also provides many different postures so users can make personalized routine by themselves. By using this service, you can do yoga alone at home in the right posture with your own yoga routine. Therefore it will lead to improved user's home yoga experience.

Keywords: Pose Estimation · Pose Correction · Yoga.

1 Introduction

One of easy exercises to try at home alone is yoga. Because it can be done anytime, anywhere with just a single mat unlike other exercise that require certain equipment. The key to yoga is the right posture. However, it is difficult to check your posture if you do yoga alone at home. Usually, there is no mirror room in home and even if there is, it's hard to look away during yoga. To solve this problem, we propose a yoga pose correction AI web service "YogaForm". It guides the users with TTS(Text-to-Speech) voice on what needs to be fixed for the correct posture using pose estimation model. It also provides many different postures so users can make personalized routine by themselves. By using this service, you can do yoga alone at home in the right posture with your own yoga routine.

2 Motivation and Objective

2.1 Motivation

Due to the impact of the COVID-19 pandemic, people's affinity for the digital environment has increased, with the use of health and disease management apps increasing. According to the "2023 Mobile Health and Fitness App Market Insights" report released by Sensor Tower, a global mobile market data analysis

company, the number of downloads of mobile health and fitness apps worldwide grew nearly 50% year-on-year in 2020, exceeding an all-time high of 2.7 billion. In 2021 and 2022, downloads of health and fitness apps worldwide fell somewhat as the impact of the COVID-19 pandemic weakened. However, it remains higher than it was before the pandemic, and health and fitness app downloads are expected to rise again in 2023.

With the growth of the digital health industry, the number of cases of applying AI to health and fitness apps has also increased. For instance, there is a mobile app service called "A-SQUAT" which corrects your squat posture and "9Poses" which is for your golf swing posture. For yoga, a live streaming platform "MixPose" provides analysis of yoga class students' posture.

We focused on yoga, which can be done anytime, anywhere with one mat, unlike other activities that require specific equipment and clear instructions from instructors. Lots of "Home Yoga" contents on SNS, such as YouTube and Instagram, show people's interest and demand in home yoga. Companies are also working on this problem. For example, Samsung created a yoga mat called "YogiFi" that can detect users' wrong posture through sensors and provide immediate feedback to help users correct and improve their posture. Confirming a huge demand for home yoga backed up by these cases, we have created a service for people who do yoga at home alone.

2.2 Objective

The main purpose of this service is yoga posture correction. it detect the user's posture using posture estimation AI model and provide immediate feedback compared to the standard posture. The instructions are provided using TTS Voice because it is difficult for users to look away during yoga. With this function, users will be able to correct and improve their yoga posture. It also provides a function for users to create their own yoga routine using different yoga postures provided by the service. These features will lead to improved user's home yoga experience.

3 Background and Related Work

3.1 Background

In the diverse field of fitness, AI has found various applications, including recommendation AI, pose estimation AI, object recognition AI, and more. Among these, we are planning to utilize pose estimation AI, specifically the one provided by MixPose, for our yoga-related activities. This will enable us to offer posture correction functionality in the yoga domain.

MediaPipe MediaPipe[1] is an open-source, cross-platform framework developed by Google that specializes in real-time multimedia data processing and analysis. It offers a comprehensive set of pre-built machine learning pipelines

and tools designed to make it easier for developers to work with multimedia data, such as images and videos. MediaPipe has gained popularity for its versatility and ease of use, making it a go-to choice for applications that require real-time perception and understanding of multimedia content.

Pose Estimation The module we're planning to use within the MediaPipe framework is its Pose Landmark Detection. The MediaPipe Pose Landmarker task detect landmarks of human bodies in an image or video. This task uses machine learning (ML) models that work with single images or video. The task outputs body pose landmarks in image coordinates and in 3-dimensional world coordinates.

The Pose Landmarker uses a series of models to predict pose landmarks.

Pose detection model detects the presence of bodies with a few key pose landmarks.

Pose landmarker model adds a complete mapping of the pose. The model outputs an estimate of 33 3-dimensional pose landmarks.

This models use a convolutional neural network similar to MobileNetV2 and is optimized for on-device, real-time fitness applications. This variant of the BlazePose model uses GHUM, a 3D human shape modeling pipeline, to estimate the full 3D body pose of an individual in images or videos.

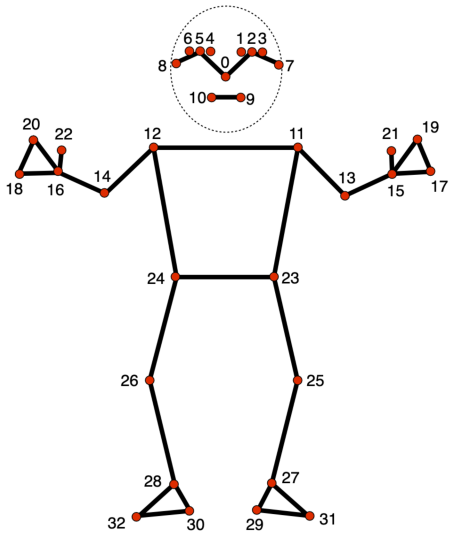

Fig. 1. 33 pose landmarks the model estimates.

The ease of integration and robustness of MediaPipe's Pose Landmarker have made it a valuable resource for developers looking to incorporate real-time human pose analysis into their applications and services, driving innovation and enhancing user experiences across various domains.

3.2 Related Work

MixPose MixPose[2] is a technology platform that specializes in AI-powered posture prediction and correction for various fitness and wellness activities, with a particular focus on yoga. MixPose leverages state-of-the-art artificial intelligence algorithms and computer vision techniques to provide real-time feedback and guidance to users as they perform different yoga poses. But the feedback provider is not AI, but the human instructor. This AI will estimate the pose and tell the overall accuracy of the pose, but can't provide specific correction guide or feedback by itself. Also it requires instructors who can stream their yoga class, unless the user can't get any guidance.

SelfYoga SelfYoga[3] is a Korean website giving overall information about yoga. It has numerous postures and its picture and the description. Also it has membership which provides yoga videos for certain circumstances such as pregnancy, pains or losing weight. However as this website has been opened since 2005, there is no developed services or communication. It's objective is to convey information, no more or no less.

4 Problem Statement and Proposed Solution

Even though Yoga is equipment-free and can be done anywhere with enough space and a mat, it has certain problems that gives constraints to people who wish to do yoga alone.

Real-time Feedback The most important part that people should focus while doing yoga is the posture. As it is about strengthening flexibility and core muscles, poses must be done in the correct way, or they might get injured. However when doing yoga alone, even if there is a mirror to assist it's hard to check and adjust our own posture ourselves.

Mixpose managed to solve the problem in a way that it utilize users' camera to show them their pose and the overall accuracy of the pose. Nevertheless it fails to give real-time feedback itself. To be specific, if they want to get a guide of correction they need an screenshot of their posture and a instructor to provide the guide.

Personalized Routine Various preferences of people led services to give personalized services, which also applies to the field of yoga. There is no service which allows users to choose postures they want to do. To do yoga alone and

with guidance at the same time, the only way is following instructor's routine. If they wish to do their own preferred pose, they can do without getting any guidance.

4.1 Proposed Solution

To solve the problem of self-yoga, we propose 'YogaForm', Home yoga web service with Yoga Pose Correction. This will solve the problems stated above. It contains two main functions, a yoga coach and a yoga routine. Two main functions will improve self-yoga experience to everyone. Providing services requires camera and enough screen size to show user's camera and the guide. A web application format could cover both requirement, so the final service would be in website service.

Yoga Coach The Yoga Coach service is a function based on the Pose Estimation module. It enables user to get real-time feedback and correction guidance. When user makes certain pose, the module estimates user's posture. Then similar to the MixPose, the service will compare the estimated pose with the standard pose. The different function of the YogaForm is that our service will calculate the angle of joints, for instance, both elbows, neck, and both knees. It will provide the way to correct their pose specifically, and this will be provided by not just screen text but actual speech. By this guidance, user can correct themselves without constantly looking at the screen.

Yoga Routine User should be provided with differentiated instructions based on the user's level. Moreover they should be able to make their own routine. The Yoga Routine will satisfy the demands. By using SelfYoga's data, we will make preset routines of varying levels. Also, for users whom has preferring posture, they are provided with the function to choose the postures. They can make personalised routines and save the routine.

4.2 Scalability

The main function of the project is correcting the users' posture by their joints. After the main function is successfully implemented, another function can be added to this project. By training an AI model to identify various yoga postures, the user can search for the name of the yoga postures by their movements. It is difficult to find the name of a certain posture in the internet alone, unless the user knows the name of it. To search for the specific posture, the users have to skim through various images, blogs, or videos, and it requires great effort. That people can find the name of the yoga posture only by their movements will be of great help for people who do yoga alone.

5 Planning in Detail

5.1 Task Assignment

The task of the project is largely divided into two parts. The first is the main goal of this project which is to implement a model that corrects users' posture by their joints. The second is to set up a web page where the users can interact with the model in real time.

Pose Correction The main goal of the project is to correct users' posture. In this project, the way of using joints to identify the posture is used.

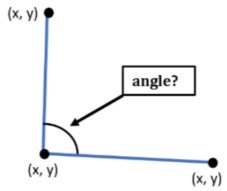

Fig. 2. Using 3 landmarks to calculate the angle.[4]

Applying mediapipe, the coordinate of 33 joint landmarks are identified in real time. We can select three different joints and by using these (x,y,z) values, we can calculate the angle of a specific part of the body. The steps for calculating the angle is: 1) calculate the vector between first and second landmarks & second and third landmarks. 2) calculate the dot product of two calculated vectors. 3) calculate the angle by using dot product and magnitude of two vectors. For example, to calculate the angle of left elbow, we select left shoulder, left elbow, left wrist as three landmarks and apply the same method as described above.

With the calculated angles of various body points, we can compare the joint angles of the users' with those of standard yoga posture. We will compare each joint angles and return the difference between the users' and the standard. Returned angles then will be told to the users for correcting the joint points and modifying the body movements.

Website Development After implementing the function of calculating the angle of the joints, we will develop the web site that assists users to use the function.

In the web page, there will be a yoga routine course with three different levels: novice, intermediate, advance. In yoga routine course, there will be 10 12 yoga postures in one routine. The users also can add their own routines by selecting postures from the provided standard yoga images. When the users select one of the yoga routines, the first standard yoga image from the routine and their own movements by camera in live are shown in the page.

To prevent the overload made in real-time streaming system, the angles of the joints are calculated only when the users maintain their postures in more than 3 seconds. After the angles are calculated and compared with the standard, the users will be coached their posture by voice. The voice to correct which part of the body by which amount of angles is coming out from the web page. Here, voice api called TTS will be used to generate the voice.

When the users maintain the correct posture for about 3 seconds, the next yoga posture is shown and it will be repeated until the last posture.

5.2 Project Schedule

The tentative schedule for the project is shown below (Fig2). We will study some technical background such as mediapipe, AI training of yoga images with some simple implementation practice and choose the appropriate framework for this project. After the mid term we will actually implement the functions and improve its performance. Then finally build the web page with the function.

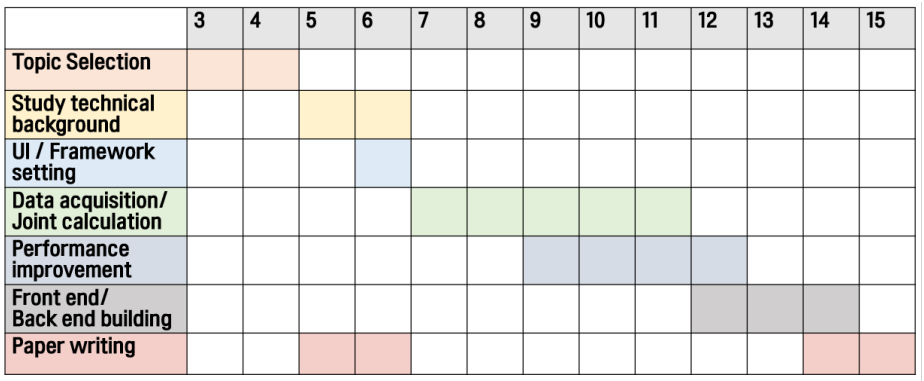

Fig. 3. A tentative schedule for the project.

5.3 Role Assignment

Since the number of team members is quite small, all the team members should work on the overall parts of the project altogether. All the members will be encouraged to implement the main function of the project with some small differences in performance enhancement and measurement. In addition to these designated tasks, the roles can be added or changed due to functionality addition or rise of a new problem while implementation.

Table 1. Main tasks of individual team members.

Name	Task
Song Jaehyun	**data collecting, model implementation, performance measurement, web development for backend**
No Choi Yuha	**data collecting, model implementation, performance improvement, web development for frontend**
Kim Hyein	**data collecting, model implementation, performance improvement, web development for frontend**

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